WHAT IS CLAIMED IS:

1. A microfluidic device, comprising:

a substrate;

a microfluidic pathway formed in or on the substrate and including a material loading end; and

a separation chamber comprising a first input opening, a second input opening, an output opening, and a material separation region disposed between the second input opening and the output opening, and wherein the material separation region is disposed further from the material loading end of the microfluidic pathway than are the second input opening and the output opening.

2. The microfluidic device of claim 1, wherein the substrate comprises a first surface and an opposite second surface and each of the first input opening, the second input opening, and the output opening is formed in the first surface of the substrate.

3. The microfluidic device of claim 1, wherein one or more of the first input opening, the second input opening, and the output opening is sealed with a frangible seal.

4. The microfluidic device of claim 1, wherein the output opening is closer to the material separation region than is the second input opening.

5. The microfluidic device of claim 1, wherein the second input opening is closer to the material separation region than is the first input opening.

6. The microfluidic device of claim 1, further comprising a first material and a second material disposed in the material separation region, wherein the first material has a density that is greater than the density of the second material, and wherein one of the first material and the second material is insoluble in the other.

7. The microfluidic device of claim 6, wherein the denser first material comprises a plurality of colloidal rod particles.

8. The microfluidic device of claim 6, wherein the denser first material comprises a plurality of nanoparticles.

9. The microfluidic device of claim 1, further comprising:

a sample-retainment feature; and

a first valved fluid communication between the sample-retainment feature and the separation chamber.

10. The microfluidic device of claim 6, further comprising a fluid disposed in the material separation region, and wherein the denser first material is water-insoluble at 25°C,

and the denser first material and the fluid together comprise a suspension, a mixture, an emulsion, or a combination thereof.

11. The microfluidic device of claim 1, further comprising a liquid disposed in the material separation region.

12. The microfluidic device of claim 11, wherein the liquid comprises water or an aqueous solution.

13. The microfluidic device of claim 1, wherein the material-trapping region comprises a U-shaped channel.

14. The microfluidic device of claim 1, wherein the substrate includes an axis of rotation, and wherein the material loading end is closer to the axis of rotation than is the separation chamber.

15. The microfluidic device of claim 1, wherein the substrate includes a rectangular-shaped top surface.

16. The microfluidic device of claim 1, wherein the substrate is disc-shaped.

17. The microfluidic device of claim 1, wherein the separation chamber includes nanoparticles disposed therein.

18. A system comprising:

the microfluidic device of claim 1;

a rotatable platen;

a holder for holding the microfluidic device on or in the rotatable platen; and

a drive unit operatively connected to rotate the rotatable platen.

19. A system comprising:

the microfluidic device of claim 1;

a holder for holding the microfluidic device; and

an ultrasonic device capable of producing ultrasonic energy and being operatively arranged relative to the holder to direct ultrasonic energy toward the material separation region of the microfluidic device when the microfluidic device is operably held by the holder.

20. A system comprising:

the microfluidic device of claim 1;

a holder for holding the microfluidic device; and

an electro-magnetic excitation beam source operatively arranged relative to the holder to direct excitation beams toward the material separation region.

21. The system of claim 20, further comprising an electro-magnetic emission beam detector operatively arranged relative to the holder to detect emission beams emitted from the material separation region.

22. A system comprising:

the microfluidic device of claim 1; and

a fluid handling arm, the fluid handling arm including a material supply opening and a material evacuation opening, and wherein the material supply opening and the material evacuation opening are capable of simultaneously being aligned with at least one of the first and second input openings and with the output opening, respectively, of the microfluidic device.

23. The system of claim 22, wherein the fluid handling arm includes an alignment recess to operatively align the fluid handling arm with respect to the microfluidic device.

24. A method comprising:

providing a microfluidic device comprising a microfluidic pathway, the microfluidic pathway including a material separation region, an input opening in fluid communication with the material separation region, and an output opening in fluid communication with the material separation region, wherein the material separation region is disposed between the input opening and the output opening;

providing a first material having a first density and a second material having a second density that is less than the first density, in the material separation region;

separating the first material from the second material in the material separation region; and

removing the second material, without removing the first material, from the material separation region.

25. The method of claim 24, wherein the first material comprises water-insoluble colloidal rod particles.

26. The method of claim 24, wherein the first material comprises purification particles.

27. The method of claim 24, wherein the material separation region comprises a U-shaped channel.

28. The method of claim 24, further comprising mixing a sample with the first material in the material separation region to form a product.

29. The method of claim 28, further comprising removing the product from the material separation region.

30. The method of claim 28, wherein the mixing comprises ultrasonically mixing together the sample and the first material to form a product.

31. The method of claim 24, wherein the separating comprises spinning the microfluidic device.

32. The method of claim 24, wherein the second material comprises a carrier and removing the second material comprises causing a pressure differential across the material separation region.

33. The method of claim 29, wherein removing the product comprises causing a pressure differential across the material separation region.

34. The method of claim 24, wherein the denser first material comprises optically detectable markers, and the method further comprises irradiating the optically detectable markers with electromagnetic radiation.

35. The method of claim 34, further comprising detecting emission beams emitted from the optically detectable markers.

36. The method of claim 24, further comprising examining the denser first material with an electron microscope.

37. The method of claim 24, wherein the denser first material is water-insoluble at 25°C and the denser first material and the second material together comprise a suspension, a mixture, an emulsion, or a combination thereof.

38. The method of claim 28, wherein the mixing comprises providing at least one air bubble in the material-trapping region.

39. The method of claim 24, wherein one of the first material and the second material is insoluble in the other.

40. The method of claim 24, wherein the first material is a nanoparticle.

41. A method comprising:

providing a microfluidic device comprising a microfluidic pathway, the microfluidic pathway including a material separation region, an input opening in fluid communication with the material-trapping region, and an output opening in fluid communication with the material-trapping region;

providing a first material and a multi-component sample in the material separation region;

reacting the first material with one or more components of the multi-component sample, in the material separation region to form a product and unmarked sample components;

separating the product from the unmarked sample components, in the material separation region; and

removing the unmarked sample components without removing the product, from the material separation region.

42. The method of claim 41, wherein the first material comprises water-insoluble colloidal rod particles.

43. The method of claim 41, wherein the first material comprises nanoparticles.

44. The method of claim 41, wherein the material separation region comprises a U-shaped channel.

45. The method of claim 41, further comprising:

mixing a fluid with the separated product in the material separation region; and

separating the product from the wash fluid.

46. The method of claim 41, further comprising removing the product from the material-trapping region.

47. The method of claim 45, wherein the mixing comprises ultrasonically mixing together the product and the fluid.

48. The method of claim 41, wherein the separating comprises spinning the microfluidic device.

49. The method of claim 41, wherein the first material comprises optically detectable markers, and the method further comprises irradiating the optically detectable markers with electromagnetic radiation.

50. The method of claim 49, further comprising detecting emission beams emitted from the optically detectable markers.